CLAIMS

What is claimed is:

1. A method of forming a pattern on a resist comprising:

providing a substrate having a resist disposed thereon and located to receive an electron beam;

exposing the resist with at least one generally rectangular-shaped shot from the electron beam to form a first feature;

relatively altering a rotational orientation of the substrate and a path of the generally rectangular-shaped shot with respect to each other by a predetermined angle; and

exposing the resist with at least one additional generally rectangular-shaped shot from the electron beam to form a second feature with at least one linear, peripheral edge substantially oriented at the predetermined angle relative to the first feature.

2. The method according to claim 1, further comprising forming the first feature using two or more generally rectangular-shaped shots from the electron beam, wherein each generally rectangular-shaped shot is abutted to an adjacent generally rectangular-shaped shot to form a larger substantially contiguous feature.

3. The method according to claim 2, further comprising forming the second feature using two or more generally rectangular-shaped shots from the electron beam, wherein each generally rectangular-shaped shot is abutted to an adjacent generally rectangular-shaped shot to form a larger substantially contiguous feature.

4. The method according to claim 1, further comprising developing the resist to form a mask on the substrate.

5. The method according to claim 1, wherein the relatively altering the rotational orientation of the substrate and the path of the generally rectangular-shaped shot is effected by rotating the substrate by the predetermined angle.

6. The method according to claim 1, wherein the relatively altering the rotational orientation of the substrate and the path of the generally rectangular-shaped shot is effected by rotating an apparatus for defining the path of the generally rectangular-shaped shot by the predetermined angle.

7. The method according to claim 1, further comprising selecting the substrate to include a semiconductor material.

8. The method according to claim 1, further comprising selecting the substrate to include a glass material.

9. A method of forming a pattern on a resist comprising:

providing a substrate having a resist disposed thereon and located to receive an electron beam, the substrate having a reference coordinate system defined by a first coordinate system having an X axis perpendicular to a Y axis and a second coordinate system having an X′ axis perpendicular to a Y′ axis, wherein the first coordinate system is oriented at a predetermined angle relative to the second coordinate system;

exposing the resist with at least one generally rectangular-shaped shot from the electron beam to form at least one non-angled feature, wherein a first edge of the at least one generally rectangular-shaped shot is generally parallel to the X axis and a second edge of the at least one generally rectangular-shaped shot is generally parallel to the Y axis;

relatively altering a rotational orientation of the substrate and a path of the generally rectangular-shaped shot with respect to each other by a predetermined angle; and

exposing the resist with at least one additional generally rectangular-shaped shot from the electron beam to form at least one angled feature, wherein a first edge of the at least one additional generally rectangular-shaped shot is generally parallel to the X′ axis and a second edge of the at least one additional generally rectangular-shaped shot is generally parallel to the Y′ axis.

10. The method according to claim 9, further comprising forming the at least one non-angled feature using two or more generally rectangular-shaped shots from the electron beam, wherein each generally rectangular-shaped shot is abutted to an adjacent generally rectangular-shaped shot to form a larger substantially contiguous feature.

11. The method according to claim 10, further comprising forming the at least one angled feature using two or more generally rectangular-shaped shots from the electron beam, wherein each generally rectangular-shaped shot is abutted to an adjacent generally rectangular-shaped shot to form a larger substantially contiguous feature.

12. The method according to claim 9, further comprising developing the resist to form a mask on the substrate.

13. The method according to claim 9, wherein the relatively altering the rotational orientation of the substrate and the path of the generally rectangular-shaped shot is effected by rotating the substrate by the predetermined angle.

14. The method according to claim 9, wherein the relatively altering the rotational orientation of the substrate and the path of the generally rectangular-shaped shot is effected by rotating an apparatus for defining the path of the generally rectangular-shaped shot by the predetermined angle.

15. The method according to claim 9, further comprising selecting the substrate to include a semiconductor material.

16. The method according to claim 9, further comprising selecting the substrate to include a glass material.

17. A method of forming a pattern on a resist, the pattern including at least one non-angled feature and at least one angled feature substantially oriented at a predetermined angle relative to the at least one non-angled feature comprising:

providing a substrate having a resist disposed thereon and located to receive an electron beam; and

determining whether a first time required to form the at least one angled feature of the pattern using two or more stepped generally rectangular-shaped shots from the electron beam is greater than or less than a second time required to relatively alter a rotational orientation of the substrate and a path of the generally rectangular-shaped shot with respect to each other by the predetermined angle and subsequently form the

at least one angled feature using at least one generally rectangular-shaped shot from the electron beam.

18. The method according to claim 17, wherein upon determining the first time to be less than the second time:

forming the at least one non-angled feature using at least one generally rectangular-shaped shot from the electron beam.

19. The method according to claim 18, further comprising forming the at least one non-angled feature using two or more generally rectangular-shaped shots from the electron beam, wherein each generally rectangular-shaped shot is abutted to an adjacent generally rectangular-shaped shot to form a larger substantially contiguous feature.

20. The method according to claim 18, further comprising forming the at least one angled feature on the resist using the two or more stepped generally rectangular-shaped shots from the electron beam without rotating the substrate or an apparatus for defining the path of the generally rectangular-shaped shot.

21. The method according to claim 20, further comprising developing the resist to form a mask on the substrate.

22. The method according to claim 17, wherein upon determining the first time to be greater than the second time:

exposing the resist with at least one generally rectangular-shaped shot from the electron beam to form the at least one non-angled feature;

relatively altering a rotational orientation of the substrate and the path of the generally rectangular-shaped shot with respect to each other by the predetermined angle; and

exposing the resist with at least one additional generally rectangular-shaped shot from the electron beam to form the at least one angled feature.

23. The method according to claim 22, further comprising forming the at least one non-angled feature using two or more generally rectangular-shaped shots from the electron beam, wherein each generally rectangular-shaped shot is abutted to an adjacent generally rectangular-shaped shot to form a larger substantially contiguous feature.

24. The method according to claim 23, further comprising forming the at least one angled feature using two or more generally rectangular-shaped shots from the electron beam, wherein each generally rectangular-shaped shot is abutted to an adjacent generally rectangular-shaped shot to form a larger substantially contiguous feature.

25. The method according to claim 22, wherein the relatively altering the rotational orientation of the substrate and the path of the generally rectangular-shaped shot is effected by rotating the substrate by the predetermined angle.

26. The method according to claim 22, wherein the relatively altering the rotational orientation of the substrate and the path of the generally rectangular-shaped shot is effected by rotating an apparatus for defining the path of the generally rectangular-shaped shot by the predetermined angle.

27. The method according to claim 22, further comprising developing the resist to form a mask on the substrate.

28. The method according to claim 17, further comprising selecting the substrate to include a semiconductor material.

29. The method according to claim 17, further comprising selecting the substrate to include a glass material.

30. A method of forming a pattern on a resist, the pattern including at least one non-angled feature and at least one angled feature substantially oriented at a predetermined angle relative to the non-angled feature comprising:

providing a substrate having a resist disposed thereon and located to receive an electron beam, the substrate having a reference coordinate system defined by a first coordinate system having an X axis perpendicular to a Y axis and a second coordinate system having an X′ axis perpendicular to a Y′ axis, wherein the first coordinate system is oriented at a predetermined angle relative to the second coordinate system; and

determining whether a first time required to form the at least one angled feature of the pattern using two or more stepped generally rectangular-shaped shots from the electron beam is greater than or less than a second time required to relatively alter a rotational orientation of the substrate and a path of the generally rectangular-shaped shot with respect to each other by the predetermined angle and subsequently form the at least one angled feature using at least one generally rectangular-shaped shot from the electron beam.

31. The method according to claim 30, wherein upon determining the first time to be less than the second time:

forming the at least one non-angled feature using at least one generally rectangular-shaped shot from the electron beam.

32. The method according to claim 31, further comprising forming the at least one non-angled feature using two or more generally rectangular-shaped shots from the electron beam, wherein each generally rectangular-shaped shot is abutted to an adjacent generally rectangular-shaped shot to form a larger substantially contiguous feature.

33. The method according to claim 31, further comprising forming the at least one angled feature on the resist using the two or more stepped generally rectangular-shaped shots

from the electron beam without rotating the substrate or an apparatus for defining the path of the generally rectangular-shaped shot.

34. The method according to claim 32, further comprising developing the resist to form a mask on the substrate.

35. The method according to claim 30, wherein upon determining the first time to be greater than the second time:

exposing the resist with at least one generally rectangular-shaped shot from the electron beam to form the at least one non-angled feature, wherein a first edge of the at least one generally rectangular-shaped shot is generally parallel to the X axis and a second edge of the at least one generally rectangular-shaped shot is generally parallel to the Y axis;

relatively altering a rotational orientation of the substrate and the path of the generally rectangular-shaped shot with respect to each other by the predetermined angle; and

exposing the resist with at least one additional generally rectangular-shaped shot from the electron beam to form the at least one angled feature, wherein a first edge of the at least one additional generally rectangular-shaped shot is generally parallel to the X′ axis and a second edge of the at least one additional generally rectangular-shaped shot is generally parallel to the Y′ axis.

36. The method according to claim 35, further comprising forming the at least one non-angled feature using two or more generally rectangular-shaped shots from the electron beam, wherein each generally rectangular-shaped shot is abutted to an adjacent generally rectangular-shaped shot to form a larger substantially contiguous feature.

37. The method according to claim 36, further comprising forming the at least one angled feature using two or more generally rectangular-shaped shots from the electron beam, wherein each generally rectangular-shaped shot is abutted to an adjacent generally rectangular-shaped shot to form a larger substantially contiguous feature.

38. The method according to claim 35, wherein the relatively altering the rotational orientation of the substrate and the path of the generally rectangular-shaped shot is effected by rotating the substrate by the predetermined angle.

39. The method according to claim 35, wherein the relatively altering the rotational orientation of the substrate and the path of the generally rectangular-shaped shot is effected by rotating an apparatus for defining the path of the generally rectangular-shaped shot by the predetermined angle.

40. The method according to claim 35, further comprising developing the resist to form a mask on the substrate.

41. The method according to claim 30, further comprising selecting the substrate to include a semiconductor material.

42. The method according to claim 30, further comprising selecting the substrate to include a glass material.

43. An electron beam lithography system comprising:

an electron emitter capable of emitting an electron beam;

at least one lens spaced apart from the electron emitter and located coaxially for the electron beam to pass therethrough;

at least one deflector for controlling a path of the electron beam;

an apparatus for defining a shape of an electron beam path therethrough;

a projection lens located to receive the electron beam from the apparatus for defining the shape of the electron beam path therethrough; and

a stage configured to support a substrate and located in the path of the electron beam, wherein at least one of the stage and the apparatus for defining the shape of the electron beam path therethrough are operably coupled to a controller for controlling at least a relative rotational position thereof.

44. The electron beam lithography system of claim 43, wherein the stage is rotatable and operably coupled to the controller for controlling at least a rotational position of the stage.

45. The electron beam lithography system of claim 44, further comprising a laser interferometer for determining the at least a rotational position of the stage.

46. The electron beam lithography system of claim 44, wherein the stage is rotatable about an axis substantially perpendicular to a plane of the stage.

47. The electron beam lithography system of claim 46, wherein the stage is translatable in the plane of the stage.

48. The electron beam lithography system of claim 43, wherein the apparatus for defining the shape of the electron beam therethrough are rotatable and operably coupled to the controller for controlling at least a rotational position thereof.

49. The electron beam lithography system of claim 48, further comprising a laser interferometer or a rotary encoder for determining the at least a rotational position of the apparatus for defining the shape of the electron beam therethrough.

50. The electron beam lithography system of claim 48, further comprising a drive for effecting the rotation of the apparatus for defining the shape of the electron beam therethrough.

51. The electron beam lithography system of claim 44, wherein the apparatus for defining the shape of the electron beam therethrough is rotatable and operably coupled to the controller for controlling at least a rotational position thereof.

52. The electron beam lithography system of claim 51, further comprising a laser interferometer or a rotary encoder for determining the at least a rotational position of the apparatus for defining the shape of the electron beam therethrough.

53. The electron beam lithography system of claim 52, further comprising a drive for effecting the rotation of the apparatus for defining the shape of the electron beam therethrough.